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THE PROBLEM OF RELIABILITY OF RUSSIAN MAPS

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I. INTRODUCTION

The following statements are based on the assumption that modern (1947-) Russian maps will be available in this country. This eventuality makes some estimate of their reliability mandatory. Since the author has none of these maps in his possession at this time, no final judgement can be made. Several items of note, however, should be recorded. Additional data will be submitted from time to time to augment this preliminary report.

II. RELIABILITY OF RUSSIAN MAPS

The problem of evaluation Russian maps is threefold:

- (a) The reliability of the grid.
- (b) The reliability of location of individual geographic objects in respect to each other, and
- (c) The reliability of the content of each map.

Nothing can be stated at this time about item (c) since we have none of these newer sheets and since such an analysis must be on an individual sheet-to-sheet basis.

IIa. RELIABILITY OF THE RUSSIAN GRID

On August 12, 1946 the Collegium of the Main Directorate of Geodesy and Cartography at the Council of Ministers of the U.S.S.R. adopted the resolution introducing the new system of coordinates based on Krasovskiy's ellipsoid (major semiaxis 6,378,245 meters, reciprocal of flattening 298.3)

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oriented at Pulkovo (center of the round hall of the Pulkovo Astronomical Observatory). This system is known as "the system of 1942".

The original resolution as well as the detailed instructions for putting it into effect can be found in Sbornik Nauchno-Tekhnicheskikh Proizvodstvennykh Statey po Geodezii, Kartografii, Topografii, Aeros"yemke i Gravimetrii, No. 16, 1948, pp. 79-85. From this source most of the following information is extracted.

Prior to 1946 Russian maps were based on not one but two geodetic systems: Pulkovo (1932) Svobodnenskaya. Both were referred to the Bessel's ellipsoid but with datums at Pulkovo and at Svobodnyy (near Khabarovsk). Geodetic networks computed on these two systems, eastward from Pulkovo and westward from Svobodnyy, could not be reconciled. The difference between the coordinates of a point in central Siberia as computed in the two systems amounted to as much as 900 meters. This was the fundamental reason necessitating a complete revision of the existing geodetic network and derivation of Krasovskiy's ellipsoid.

So far as cartography is concerned we should note (Section 3, paragraph A) that all triangulations and leveling made before 1946 are to be recomputed and readjusted. In the meantime, conversion tables for corrections to the rectilinear Gauss-Kr^uger coordinates to reduce the two old systems to the new system of 1942 are given as follows:

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Corrections to be applied to System of 1932 in order
to reduce it to System 1942 (in meters).

36		37		38		39		40	
dx	xy	dx	dy	dx	dy	dx	dy	dx	dy
K		+809	-13	+812	-65	+817	-116	+825	-150
L	+803 +37	804	13	808	61	811	110	823	156
M	803 35	804	14	806	60	812	108	822	156
N	802 33	803	14	806	60	811	108	822	156
O	803 34	800	13	805	61	811	107	822	156
P	799 34	800	15	804	62				
R		798	16						

41		42		43		44		45		46	
dx	dy	dx	dy	dx	dy	dx	dy	dx	dy	dx	dy
J	+837 -197	+853 -247									
K	837 197	855 246	+876 -292								
L	836 202	853 246	879 289	+904 -331							
M	836 201	859 251	881 292	906 332	+935 -370						
N	837 204	858 250	881 293	908 333	937 370	+970 -406					
O	838 203	858 249				971 406					

Corrections to be applied to the Svobodnenskaya System
in order to reduce it to the system of 1942 (in meters).

47		48		49		50		51		52		53		54	
dx	dy	dx	dy	dx	dy	dx	dy	dx	dy	dx	dy	dx	dy	dx	dy
M		+641 +263	+625 +200	+613 +134				+604 +8	+606 -58						
N	+670 +319	643 263	622 199	612 134	+603 +70	602 8	605 59	+611 -124							
O	670 323	642 +226			609 135	600 68									

*obviously a misprint, should be 262

The precision of these corrections is estimated at 2 or 3 meters,
that is, quite adequate for maps of a scale of 1:25,000 and smaller.

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Examples: To convert G-K rectilinear coordinates of the 1932 system of Shlanga as Sheet N-38 to the coordinates of the 1942 system:

x_{1932}	6080338 met.	y_{1932}	8652439 met.
dx	+806		-60
x_{1942}	6081144	y_{1942}	8652379

To convert G-K coordinates of Svobodnenskaya system to the coordinates of the 1942 system (Sheet E-52)

$x_{svob.}$	5693192 met	$y_{svob.}$	22543252 met.
dx	+602		+8
x_{1942}	5693794	y_{1943}	22543260

Notice: in Russian practice the coordinate x is directed along the meridian and is the actual coordinate; y, is directed along the parallel and is known as the conditional coordinate. The last six figures on the distance from the axis meridian minus 500,000, positive direction being eastward. In the first example the distance from the meridian 45° E is 152439 meters eastward, in the second the distance from the meridian 129° E is 43252 meters also eastward. The one or two figures preceding these six figures merely denote the column, the number is IMW notation minus 30. thus 8=38-30 in the first example, and 22=52-30.

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Maps of the scale of 1:200,000 and smaller printed before 1946 are not to be recompiled and re-issued merely because of the introduction of the new system."

The last statement means that maps on the scale of 1:200,000, 1:500,000 and 1:1,000,000 are to be issued on the 1942 system only if the present supply of these maps is exhausted.

We may add here that since 1939 in the Russian maps of scales larger than 1:1,000,000 the Gauss-Krüger (a transverse cylindrical) projection has been used. The 1:1,000,000 map is based on the modified Lallemand projection, that is, essentially on the same projection as used for the one millionth map of the world in other countries.

The conversion tables given above for the G-K projection apparently apply also to the International Map of the World projection, even though it is a polyconic rather than a cylindrical projection. The problem of the correspondence of the two projections is treated in some detail by M. D. Solov'yev (Kartograficheskiye Proyektzii, 1946, pp. 332-354) in which he comes to the conclusion that the coordinate x in both projections is identical, and the difference in coordinate y is insignificant.

In practice the simultaneous existence of three kinds of Russian maps based on different ellipsoids and different datums is very confusing. This fact should be kept in mind at any attempt to utilize for cartography Russian data which are not connected with the adjusted triangulation system, such as astronomic determinations or the results of the astronomic-gravity adjustments.

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IIb. THE RELIABILITY OF LOCATION

If we remember that the history of Russian exploration is the progressive movement from the west to the east and northeast, we may lay down a general rule: Cartography is less precise the farther east and northeast we proceed from Moscow. There have been many complaints about the poor status of cartography in such areas as the Arctic Coast of Asia, Yakutia and Kamchatka. Two more precise instances have been found and since they refer to a rather recent situation it might be worth while to discuss them in some detail.

RELIABILITY OF U.S.S.R. MAPS

(1) Eastern Coast of Taymyr Peninsula

Source: A.I. Kosoy, Na Vostochnom Poberezh'ye Taymyrskogo Poluoostrova Glavsevmorput', 1944, DLC G700.1940 K6.

This book describes the history of the exploration of the Taymyr Peninsula between Cape Chelyuskina (77°43' N, 104°12' E) and Cape Psov (76°58' N, 113°45' E). The author was an astronomer-geodesist in charge of a party of 38 men sent by the Glavsevmorput' in 1940-41 for geodetic and topographic surveys in the region. The book does not give many numerical data, yet it is full of interesting detail which will be studies later in their proper connections.

For the present purpose we restrict our attention to Kosoy's criticisms of previously existing maps, published in 1941 just a few months before the return of Kosoy's expedition of which Hydrographic Chart No. 1494 is specifically mentioned. The general conclusion is that all maps of this region published before the survey of 1940-41

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are unreliable.

Kosoy gives two sketches of the coast: one as known before 1940, the other of the coast according to the data obtained in 1940-41. There is no question as to the great difference in the coast line between these two maps.

For the purposes of comparison the corresponding sheets of the World Aeronautical Chart are considered:

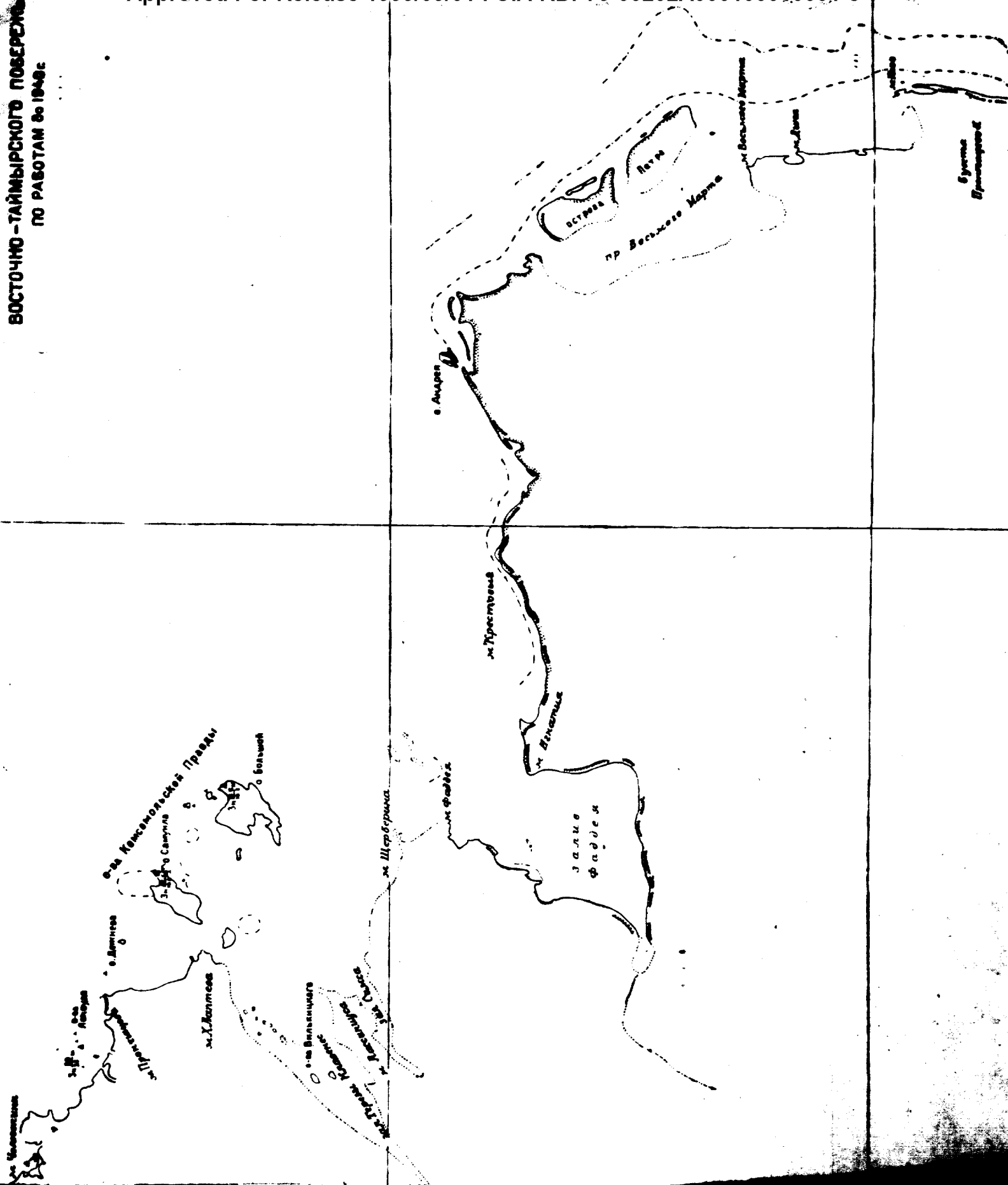
Sheet 13 (May 1951), from Cape Chelyuskina to Cape Ignatiya (76°44' N, 107°50' E). The WAC is evidently based on cartographic material dated prior to 1940. It is almost an exact copy of the older chart No. 1494 which is criticized by Kosoy. In particular, Kosoy points out that the Vil'kitskogo Islands consist of 11 islands, not of 13, as represented on previous maps and as shown on the WAC. Moreover, the configuration, size and position of these islands on Kosoy's map have nothing in common with the islands represented on the WAC. There is also considerable difference in other details.

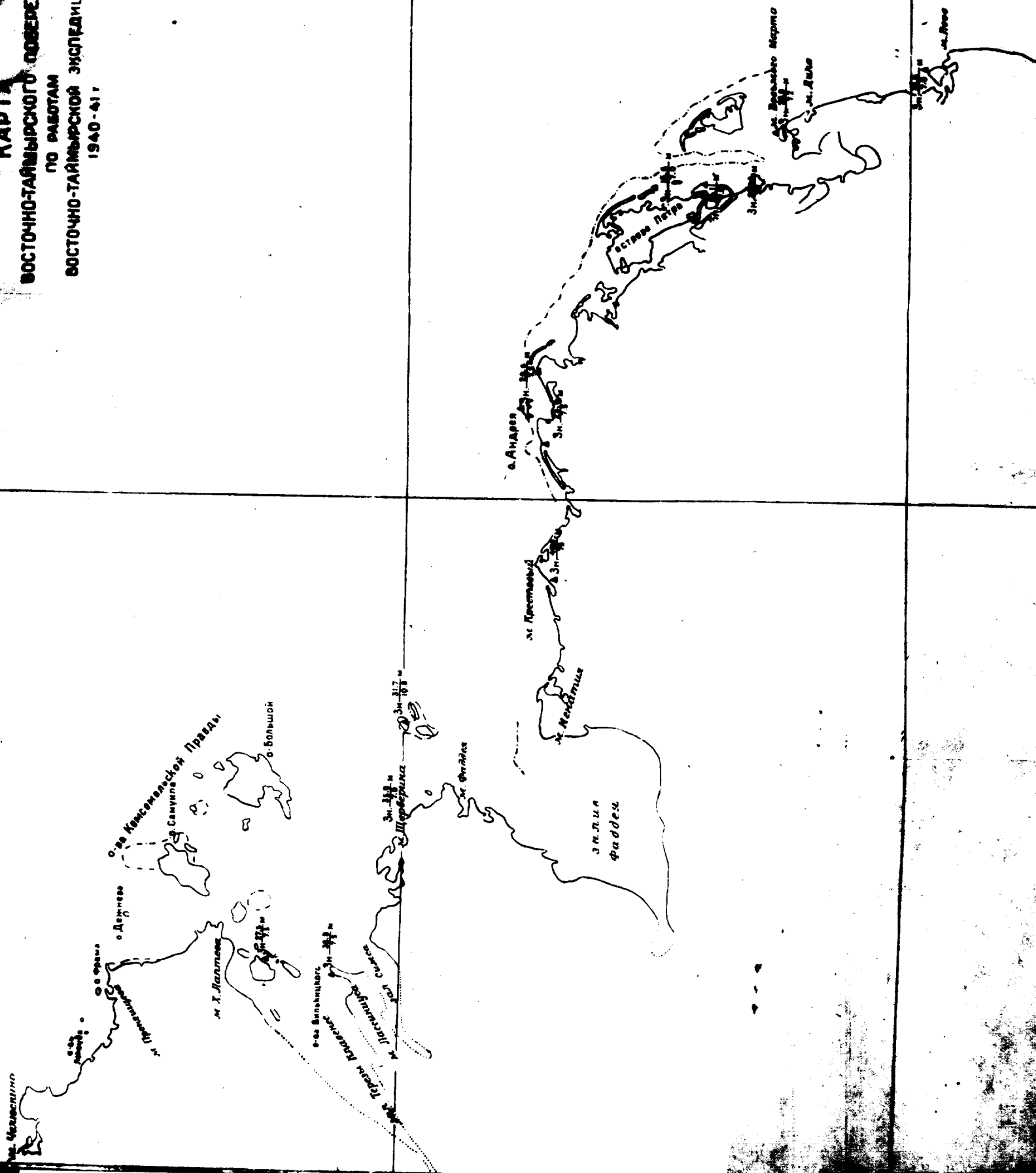
Sheet 27 (October, 1949), from Cape Ignatiya to Cape Povarnaya (76°05' N, 113°30' E, not named on the Russian map). The WAC in this region agrees very well with the general configuration of the coast and islands as represented by Kosoy, and one would think it is based on data obtained after 1940, even though the date of publication of the sheet is earlier than that of No. 13. However, a serious disagreement still exists. Kosoy gives the latitudes (no longitudes given) of three points in this region which are compared with the same points on the WAC:

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КАРТА

ВОСТОЧНО-ТАЙМЫРСКОГО ПОБЕРЕЖЬЯ
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Mys Ignatiya	76°42'01"70 ± 0128	WAC 13	76°42'10
Punkt Andreyka	76°39'45"30 ± 0124	WAC 27	76°47'16
Mys Dyka	76°11'22"19 ± 0134	WAC 27	76°12'14

As no precise location of the astropoints is given the agreement for Cape Ignatiya and Cape Dyka can be considered satisfactory. But with Punkt Andreyka (Andreyka Point) no agreement is possible. It is presumably situated on Island Andreyka which, according to Kosoy must be moved 7 miles south and 9 miles west as compared with the maps prior to 1940. This would give the latitude about 76°40'16 in fair agreement with Kosoy's figure. However, the position of this island on Kosoy's map agrees very well with that of the WAC. No explanation of this discrepancy can be suggested at the present time.

Sheet 28 (January 1949) contains only a small section of Kosoy's map in the neighborhood of Cape Psov (75°47' N, 113°45' E). The configuration of the coast on the WAC corresponds to the Russian maps prior to 1940.

(2) Yakutia

Source: F. N. Pavlov, Raboty Yakutskogo Aerogeodezicheskogo Predpriyatiya, Sbornik M.-T. i proizv. Statey, No. 14, 1946, pp. 62-80.

In this article the author describes the organization and activity of the Yakutsk Aero-geodetic Establishment. It was organized in 1942 for the purpose of speeding up the survey of this territory. Describing the difficulties of aerial photography and especially of availability of astronomic control points, the author says:

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"We should remember that the territory of Yakutia is almost unknown from the point of view of cartography, so that the precision of available maps for this territory is very low. For the purposes of aerial photography we used the maps on the scale of 1:1,000,000. In the actual use of these maps our experience was that some objects were placed with errors of 30-40 kil., and that in the most populated sections of the territory".

There are other statements of the same sort in this article showing that available maps in Yakutia as late as 1943-44 were quite unreliable.

It follows that the available sheets of the 1:1,000,000 map of this territory should be accepted with certain reservations, unless they are of the year 1945 and later.

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